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Requirement of Green Supply Chain Management

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Abstract: Global warming is a serious problem intimidate organism. It causes of green house's gasses organism for especially, human reproduce Carbondioxyde (CO_2) gas excessively. Production activity on companies which involving much of energy using, so, it produce CO_2 emission. PT Holcim Indonesia is one of company having production activity on industrial cement. To compute the energy flow on production process is hard enough, so, it needs proper method, time and much money. Therefore, in thhis research simulation model is held to show energy flow on cement production process inside PT Holcim Indonesia Tbk Pabrik Cilacap through Technomatix Plant Simulation Software which have a purpose to control the CO_2 emission in order to comply the require of grren supply chain management, also to predict CO_2 emission value as the output of production process of cement production. The result of this research show that throughout production process the value of CO_2 emission is 52.086,6 kg. CO_2 everyday, this is equivalent to 1.562.598 kg. CO_2 on 30 days production time, it shows that the emission on PT Holcim Indonesia Pabrik Cilacap out of specified threshold, that is 8.000 kg.CO_2. Thus, PT Holcim Indonesia Pabrik Cilacap need to control the production of CO_2 emission in order to get green supply chain management industry through replace alternative fuels with sekampadi and also apply reboisation system on limestone quarry. It shows that PT Holcim Indonesia Pabrik Cilacap is industrial company which is comply the require of green supply chain management.

Key words: Green supply chain management, cement, supply chain management, emission, Pabrik Cilacap, PT Holcim

INTRODUCTION

Global warming was being serious problem that intimidate organism. Based on the research of working group 3 Intergovernment Panel on Climate Change (IPCC), the cause of global waeming is green house gas outcoming from organism, especially human (IPCC., 2015). Fossil fuel is one biggest producer of green house gas of human that content of carbondioxyde gas. In other side, production activity on company which is need energy and produce high carbondioxyde gas give direct impact on global warming (Lee, 2012).

Production process is an activity to make semi-finished good things or finished thing from the input, so, it produces output (Gaspersz, 2007). This process is important side on company, especially on manufacture company. However, businessmen are careless the impact of production activity which produce CO_2 emission on environment and also have the impact on global warming. PT Holcim Indonesia, especially, Pabrik Cilacap is one of company with production process on producing cement (Fig. 1).

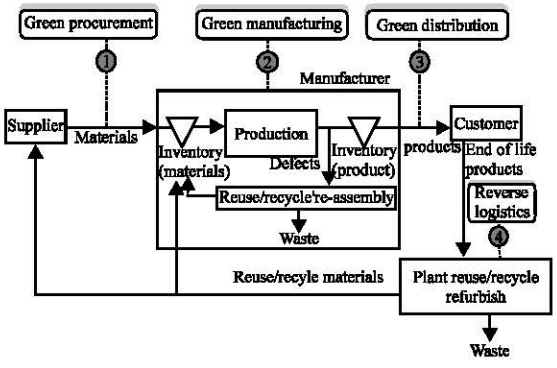

Fig. 1: Activity on green supply chain management

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Green supply chain cause the industrial increasing the stability about marketing performance and new environment problem like saving energy using and pollution abatement not only for long-term survival but also long-term profitability. Company need to repair the networking or increase the supply chain in order to waste reduction and operating efficiency, including delivery product and service.

Literature review: The impact of globalitation challenge nowadays is company need to make a change fastly and continuesly in order to compete and reach solid position on market competition. One of influental aspect on the succesfull company is how the company increase source effectivity in order to increase the profitability through supply chain management.

Supply chain is networking to product and conduct a product into last user hand (Srivastava, 2007). Knowing the negative impact of production process on company. It encourage companies to integrate green aspect into the supply chain which known as Green Supply Chain Management (GSCM). GSCM can be avowed as green purchase, material management, distribution and green marketing, and also reverse logistic (Pujawan, 2005).

Process production in company require energy to operate, so, globaly it will going to be the main contributor of CO_2 emission (Anonymous, 2014). Cause of that, proper method to calculate energy flow in a production process is required. However, those method need time and much money. One of applied method is simulation. But simulation have kind of models, the proper model is require to get precise result. On this research, simulation model is required to draw energy flow when the cement production process is held on PT Holcim Indonesia Tbk Pabrik Cilacap through Technomatix Plant Simulation Software,this have purpose to control CO_2 emission for comply GSCM require, also predict the value of CO_2 emission.

MATERIALS AND METHODS

The main object of this research is measuring CO_2 emission from the result of energy consumption measurement while the production process is continue on PT Holcim Indonesia. This CO_2 emission measurement using simulation method through Technomatix Plant Simulation 12 Software. The first stage on this measurement is preparing cement production data such as: raw material data, cement production data, energy consumption data and time of process machine.

After all the data is complete, then we make a real process model to present in the company. After that simulation is being required through technomatix plant simulation software. Here is a research framework of this research about measuring CO_2 emission on PT. Holcim Indonesia (Fig. 2).

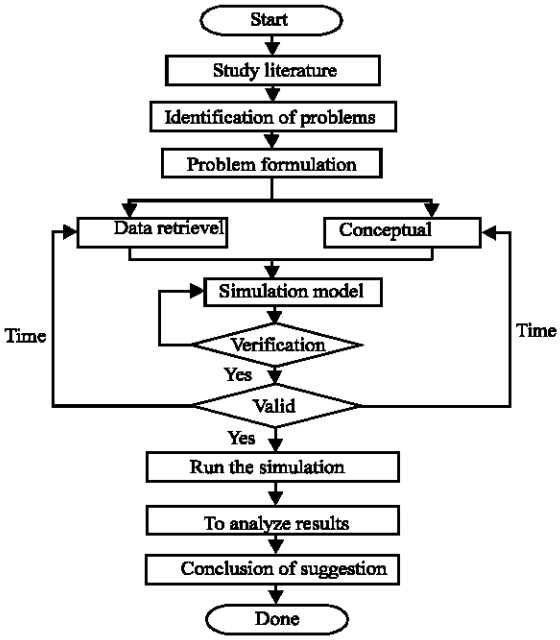

Fig. 2: Research framework

RESULTS AND DISCUSSION

The data retrieval was held through two ways, that retrieval of primary data and retrieval of secondary data, pprimary data is a data which taking from the place result directly, it used survey and observe methods, secondary data is a data which is gotten by mediator, generally, it can be evidenve or history report from archives.

The require data of this research is: plot production, result of cement production (everyday), raw material data, time of live machine, each machine energy. This research is an implementation of production process through Technomatix Plant Simulation Software. On the manufacture process, the model simulation based on the analyze about suitability of resulting model is required. It used to verrification and validation on the created model. Comparation between the result of output based on historic data and simulation data are required, so, we can conclude from the comparation that created model was present in real or not.

Furthermore, the conversion of energy into CO_2 units to find out how much CO_2 emissions generated during the production process. Didapatlah further CO_2 emission values to analyze the carbon emissions of the cup and

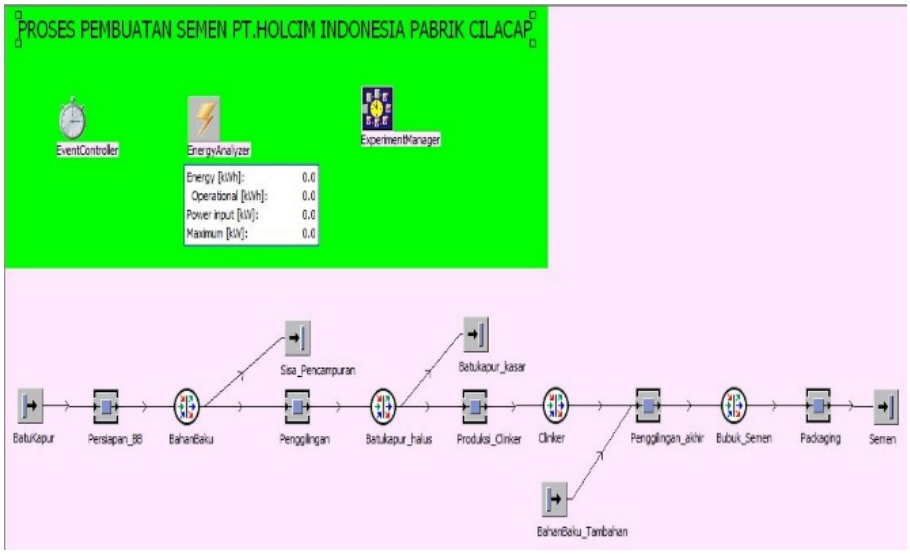

Fig 3: Frame work of process cement production in pt.holcim indonesia

Simulation time: 1:00:00:00.0000

Cumulated statistics of the parts which the drain deleted

Object	Name	Mean Life Time	Throughput	TPH	Production	Transport	Storage	Value added	Portion
Batukapur_kasar	Entity	3:23.7075	424	18	100.00%	0.00%	0.00%	41.73%	
Semen	Entity	6:47.5661	847	35	100.00%	0.00%	0.00%	48.01%	
Sisa_Pencampuran	Entity	1:41.7397	849	35	100.00%	0.00%	0.00%	3.93%	

Fig. 4: Simulation results for one day production

trade policies. Is the CO_2 emissions exceed the limit set or not. If the emission values exceed the minimum specified carbon emission calculation it is necessary to calculate the social cost of the excess CO_2 emissions. CO_2 emission values can be derived from a mathematical formula in the calculation of CO_2 based on electrical energy consumption is as follows:

$$E^{E}_{CO_2} = \sum_{t=1}^{t=1} A_{(E)t} \times F_{(E)t} \quad (1)$$

Where:

$E^{E}_{Co_2}$ = Total Emission CO_2(kg.CO_2)
$A_{(E)t}$ = Total electricity consumption (kWh)
$F_{(E)t}$ = Electricity emission factors (kg/kWh) with amount 0.725 kg/kWh

While the value of social costs of excess CO_2 emissions can be obtained from a mathematical formula that can be seen in Eq. 2.

$$\text{Social costs} = \text{Price carbon} * CO_2 \text{ emissions excess} \quad (2)$$

Explanation: Carbon = $ 0.2/ton.CO_2. Figure 3 shows the flow of the production process of cement production.

Table 1: Energy consumption during one day

Type of data	Total energy
Energy (kWh)	69.448.8
Operational (kWh)	09.873.2
Power input (kW)	02.806.2
Maximum (kW)	04.032.8

From these figures there are event controler, energy analyzer, experiment manager, source and drain singleproc. The images show, the main input in the manufacturing process of cement is limestone, while the results obtained is cement. In this study only focused on prehitungn CO_2 emissions from the cement production process alone. Based on the simulation results obtained for a one-day simulation products presented in Fig. 4.

Based on the Fig. 4, it can be seen that in the first days of production can produce about 847 tons of cement with the results as much as 35 ton/h. For a production value of 100%. This is because all the machine work without stopping. Moreover, it can be seen the pattern of the amount of energy produced during a production day as Table 1.

Table 2: Output paired sample t-test result

	Paired differences							
				95% Confidence interval of the difference				
Variables	Mean	SD	SE mean	Lower	Upper	t-value	df.	Sig. (2-tailed)
Pair data_historis-1 data_simulasi	16.70 000	48.5010 8	8.85505	-1.41060	34.81060	1.886	29	0.069

Based on Table 1 explains that during the first day of production machines in operation generates an energy of 69448.2 kWh. However, the results are do not known whether the models are made are in accordance with the real conditions of the company or not, so, we need a validation test to ensure the simulation model has been representing the real system.

According to Table 2 can be seen that the significant value of 0.69. From these results it can be concluded that both the samples do not have the average difference is striking. This is because the significance value greater than the probability of error is 0.05. Hence, it can be concluded that the models built in common, so that, the model is considered valid and has been representing the real system.

Based on a simulation model that has been made, it has been known that the energy consumption is used on each machine. Moreover, it can also unknown energy consumption every day. Thus, based on the results of the energy can be known total CO_2 emissions produced at each station. Based on the total daily energy consumption can be calculated CO_2 emission values as follows:

$$E^{E}_{CO_2} = \sum_{t=1}^{t=T} A_{(E)t} \times F_{(E)t}$$

$$= 69.448{,}8 \text{ kWh} \times 0.75 \text{ kg/kWh}$$

$$= 52.086{,}6 \text{ kg.}CO_2$$

Based on these calculations obtained value of 52086.6 kg of CO_2 emissions every day. So, we get the results of the energy expended each work station in a day of production which can be seen in Table 3.

Table 3 energid user can know an amount of carbon emissions produced each stations. The table above is known for the total overall energy consumption in one day as much 69448.8 kWh. Additionally, able to provide information about the station that produces the largest carbon emissions. From the table it is known that the end of the milling station is a station that produces the greatest carbon emissions is 20865.78 kg CO_2.

This research will try to analyze the amount of carbon emissions released by PT. Holcim Indonesia Cilacap plant. In this study, it is assumed that Indonesia join impose restrictions on carbon emissions and implement carbon emissions trading system as proposed by Wei-Hua *et al.* (2011).

Table 3: Energy consumption and carbon emissions every stations in one day

Station	Energy (kWh)	CO_2 emission (kg.CO_2)
Preparation of raw materials	03.894,15	2.920,61
Milling	20.600,13	15.450,09
Clinker production	15.816,54	11.862,41
End milling	27.821,04	20.865,78
Packaging	01.316,96	98.772,00
Total energy	69.448,80	52.086,60

Table 4: CO_2 Emission calculation

Number of days	Value of emission CO_2(kg.CO_2)
1	52.086,600
30	01.562.598

Table 4 shows that, the value of CO_2 emission in a month is 1.562.598 kg.CO_2. That value is α_0 score from the multiplication about CO_2 emission score per day with total score in a month. This research refer to the research before which held by Wei-Hua *et al.*(2011) whereas limitation emission carbon and trading emission carbon system are applied. α score as the limitation of cap carbon have 8000 kg.CO_2 value. This limitation will be used in companies as the direction to analyze CO_2 emission from PT Holcim Indonesia Pabrik Cilacap. Based on 4.14 table, the α score in a month is 1.562.598 kg.CO_2, so, it will be: 1.562.598 kg.CO_2>8.000 kg.CO_2

The result is $\alpha_0 > \alpha$, so, company produce emission out of the limitation. The exceed volume of the emission carbon in company was determined, so, the company must pay social cost to government. In this research, Wei-Hua *et al.* (2011). Price of emission carbon is \$0.2/ton.CO_2 Based on that price, company must pay as much as:

$$\text{Social costs} = \text{Carbon prices} \times \text{excess emissions } (CO_2)$$

$$= \$0.2/\text{ton. CO2 x } 1{,}554.6 \text{ tons } CO_2$$

$$= \$\ 310.92$$

Based on the result of social cost calulation, the impact of CO_2 emission is \$ 310.92. Thus, Indonesia should really apply the policy of emission carbon and PT Holcim Indonesia Pabrik Cilacap must pay \$310.92 because they got exceed of emission carbon.

CONCLUSION

The conclusion result of this research is simulation model development was proud through verrification and

validation test. Verrification test was held by verbal ways or direct interview, than validation test was held by t-test and comparing the output energy. The result of the simulation show that, a valid model have significant score >0.005, that is 0.069 and also being able to present in real. After the simulation, we will know the output of energy consumption. In a day production can be able to produce 847 ton cement with energy 69.448,8 kWh energy output. While the process production is continue, we can get the number of emission carbone. The company can be produce 52.086,6 kg.CO_2 emission everyday or being a line with 1.562.598 kg.CO_2 on 30 days production time. Based on those result, if Indonesia will apply a wisdom about limiting emission carbone, company have to pas about $ 310,92 or Rp.4.187.420 for 30 days production time. PT Holcim Indonesia have emission carbon exceed of the threshold. Controlling the CO_2 emission is one way to be green supply chain management industry.

Based on the analyze, PT Holcim Indonesia was controlling CO_2 emission such as: Pabrik Cilacap apply reboisation system on limestone quarry which has been mined. This is a way to have a healthy environment, so, the limestone mined land which is the main raw material can be regreen. PT Holcim Indonesia using Sekam padi as the alternative fuel to decrease the employing of coal as the main fuel, coal is one of un-renew nature source.

REFERENCES

Anonymous, 2014. Energy. World Bank washington D.C., USA. http://www.worldbank. org/en /topic/ energy/overview#1

Gaspersz, V., 2007. Lean Six Sigma for Manufacturing and Service Industries. PT Gramedia Pustaka Utama, Jakarta, Indonesia,.

IPCC., 2015. Climate Change 2014: Mitigation of Climate Change. Vol. 3. Cambridge University Press, UK.

Lee, K.H., 2012. Carbon accounting for supply chain management in the automobile industry. J. Cleaner Prod., 36: 83-93.

Pujawan, I.N., 2005. Supply Chain Management. Guna Widya, Surabaya, Indonesia.

Srivastava, R.K., 2007. Determination of brand loyalty factors age group-18-24. Acad. Marketing Stud. J., 11: 1-16.

Wei-Hua, L., X. Xue-cai, R. Zheng-xu and P. Yan, 2011. An emergency order allocation model based on multi-provider in two-echelon logistics service supply chain. Supply Chain Manage. Intl. J., 16: 391-400.